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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/781,314

02/17/2004

Youzhi E. Xu

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02/25/2009

INTEL/BSTZ

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EXAMINER

FISCHER, JUSTIN R

ART UNIT

PAPER NUMBER

1791

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DELIVERY MODE

02/25/2009

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<i>Office Action Summary</i>	Application No.	Applicant(s)	
	10/781,314	XU, YOUZHI E.	
	Examiner	Art Unit	
	Justin R. Fischer	1791	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 09 January 2009.
- 2a) ☐ This action is FINAL.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 16-22 and 24-30 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 16-22 and 24-30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)          | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

DETAILED ACTION

*Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 16, 17, 19-22, 24, 27, 28, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mertol (US 6,008,536, of record) and further in view of Moeller (DE 19751463, newly cited).

Mertol teaches an assembly comprising an integrated circuit 12 (heat generating device), a first thermal interface material 36 comprised of a heat curable epoxy, and a heat spreader 16 (heat dissipating device) (Column 8, Lines 22+). The reference further teaches that the heat spreader is formed of a thermally conductive material, such as metals (Column 6, Lines 9+). It is further noted that the particular method in which the polymer is applied is related to the manufacturing method and does not further define the claimed structure of the claimed apparatus/system. The reference, however, is silent as to the presence of covalent bonds between the thermal interface material and the heat sink.

Moeller, on the other hand, is directed to a method of improving adhesion between a metal surface and a heat curable resin/adhesive, such as epoxy, by including a specific additive or hardener system- in such a technique, a covalent bond is formed between the heat curable resin and the metal surface. One of ordinary skill in the art at

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the time of the invention would have found it obvious to use such a technique in the method of Mertol since it provides improved adhesion between a metal surface and a heat curable resin, such as epoxy.

Regarding claim 19, the interface material of Mertol comprises an epoxy matrix and conductive filler particles (e.g. silver) and such a composition is seen to constitute a molecular composite material.

With respect to claim 20, conductive filler particles having a wide variety of particle sizes and distributions are commonly used in thermal interface materials. One of ordinary skill in the art at the time of the invention would have found it obvious to use small and/or large filler particles and it appears that the claim language is directed to extremely smaller filler particles. Also, applicant has not provided a conclusive showing of unexpected results to establish a criticality for the claimed invention.

As to claim 22, the apparatus/system of Mertol, in view of Moeller, includes a thermal interface material comprising an epoxy matrix and a thermally conductive filler, wherein said interface material would be covalently bonded to a metal heat spreader. A fair reading of the Mertol suggests the general use of a conductive epoxy material- such a disclosure suggests the use of a wide variety of epoxies, including those having a thermal conductivity greater than 4 W/mK and applicant has not provided a conclusive showing of unexpected results to establish a criticality for the claimed conductivity.

With respect to claims 27, 28, and 30, Mertol describes the claimed flip chip assembly (Column 3, Lines 25+).

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3. Claims 16, 17, 19-22, 24-28, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith (US 20010052652) and further in view of Miyao (JP 4-364764, of record) and Moeller.

As best depicted in Figure 1, Smith teaches an assembly comprising a heat generating device 12, a first thermal interface material 14, a heat spreader 13, a second thermal interface material 16, and a heat sink 20. The reference further teaches that the interface materials comprise an epoxy matrix and conductive fibers, wherein said fibers have a thermal conductivity of at least 25 W/mK (Paragraphs 26 and 28).

Furthermore, the particular method in which the polymer is applied is related to the manufacturing method and does not further define the claimed structure of the claimed apparatus/system.

In regards to the heat sink, Smith is completely silent to the material used to form said heat sink. However, it is well known to form such heat sinks from thermally conductive materials, including metals (e.g. iron), as shown for example by Miyao. As such, one of ordinary skill in the art at the time of the invention would have found it obvious to form the assembly of Smith with a metal heat sink. In this assembly, the metal heat sink is directly adjacent a thermal interface material comprised of a thermal epoxy. It is emphasized that heat dissipating devices, in general, are formed of conductive metals or metal alloys and thus, one of ordinary skill in the art at the time of the invention would have similarly found it obvious to form the heat spreader of Smith from metal and perform the aforementioned oxidizing step.

The combination of references, however, does not expressly describe the presence of covalent bonds between the metal heat spreader and the epoxy interface material. Moeller, however, teaches a method of improving adhesion between a metal surface and a heat curable resin/adhesive, such as epoxy, by including a specific additive or hardener system- in such a technique, a covalent bond is formed between the heat curable resin and the metal surface. One of ordinary skill in the art at the time of the invention would have found it obvious to use such a technique in the method of Smith since it provides improved adhesion between a metal surface and a heat curable resin, such as epoxy.

As to claim 19, a composition of epoxy and conductive fibers is seen to constitute a molecular composite material.

With respect to claim 20, conductive fibers having a diameter of 10 microns can be used in the interface material of Smith and such an assembly is seen to define a nanocomposite material.

Regarding claims 27, 28, and 30, the claimed flip chip method represents one of the most common electronic packages in which an integrated circuit is attached to a printed circuit board. One of ordinary skill in the art at the time of the invention would have recognized the generic language of Smith as including the claimed flip chip assembly.

4. Claims 16-22 and 24-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith and further in view of Jiang (US 6,812,064, newly cited).

As detailed in the previous paragraph, Smith substantially teaches the claimed system, including a heat generating device (integrated circuit comprised of semiconductor dies), a first thermal interface material (e.g. epoxy), a heat spreader, a second thermal interface material (e.g. epoxy), and a heat sink. While the reference fails to expressly disclose the makeup of the integrated circuit, it is extremely well known and conventional to form such components from silicon. The reference, however, is silent as to the presence of covalent bonds between the silicon surface of the integrated circuit and the epoxy thermal interface material.

Jiang, however, is directed to a method of improving the adhesion between an epoxy adhesive/interface material and a silicon semiconductor die by oxidizing the silicon surface (produces some hydroxyl residues or functional groups) (Column 4, Lines 25+). One of ordinary skill in the art at the time of the invention would have found it obvious to oxidize the silicon semiconductor die (and include a coupling agent in the adhesive layer) of Smith for the reasons detailed above. It is further noted that applicant recognizes such a method (oxidizing silicon substrate) as forming covalent bonds between the silicon substrate and the epoxy interface material (see Paragraph 24 of ordinal disclosure).

As to claim 19, a composition of epoxy and conductive fibers is seen to constitute a molecular composite material.

With respect to claim 20, conductive fibers having a diameter of 10 microns can be used in the interface material of Smith and such an assembly is seen to define a nanocomposite material.

Regarding claims 27, 28, and 30, the claimed flip chip method represents one of the most common electronic packages in which an integrated circuit is attached to a printed circuit board. One of ordinary skill in the art at the time of the invention would have recognized the generic language of Smith as including the claimed flip chip assembly.

#### *Response to Arguments*

5. Applicant's arguments, see Pages 1-6, filed January 9, 2009, with respect to the rejection(s) of claim(s) 16, 17, 19-22, 24-29, and 30 under 35 USC 103 have been fully considered and are persuasive. Therefore, the rejections have been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Moeller and Jiang as set forth above.

#### *Conclusion*

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Justin R. Fischer whose telephone number is (571) 272-1215. The examiner can normally be reached on M-F (7:30-4:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Crispino can be reached on (571) 272-1226. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Justin Fischer  
/Justin R Fischer/  
Primary Examiner, Art Unit 1791  
February 18, 2009